VSV11 and VS11 Raster Graphics Systems

High performance, color and monochrome graphics display systems for Digital Equipment computers.

The VSV11 and VS11 from Digital Equipment are raster graphics display systems which incorporate the most recent developments in video engineering and graphics technology. The VSV11 is designed for use with Digital's LSI-11 computers, and the VS11 for PDP-11 and VAX computers. The powerful combination of a raster-scan display with high speed bit-slice microprocessor techniques provides rapid generation of high quality pictures. Sophisticated graphics and images can be displayed in up to 16 colors or shades of grey. Each picture (color or monochrome) is automatically refreshed by the VSV11/VS11, providing stable, easy to view picture output.

Once picture data has been loaded from the host computer, the VSV11/VS11 performs all control of picture display. Multiple VSV11/VS11 systems can be configured on one host computer.

Features
Monochrome or full color
Both the VSV11 and the VS11 can be used to drive monochrome or color display monitors. On monochrome monitors, graphics are displayed in up to 16 shades of grey. On color monitors, the user can employ up to 16 discrete colors to display data.

Options of the VSV11/VS11 are available which include either a monochrome or a color monitor:
□ Monochrome — a 12 inch, VT100-type monitor with long persistance phosphor CRT and an anti-glare shield.
□ Color — a 19 inch, high resolution monitor, with an in-line gun, long persistance phosphor CRT, with adjustment-free convergence feature.

The VSV11/VS11 is always supplied with a joystick. Models with monitors are also supplied with a keyboard. This means that they can be used not only as output devices, but also for user-interaction with the VSV11 or VS11 system. The video output of the VSV11 and VS11 conforms to RS-170 and can be used to drive monitors conforming to that standard.

Modular
The VSV11/VS11 architecture allows users to configure the system to suit their application needs. As standard, there is a switch-selectable choice of resolution and the number of colors or intensities:
512×512 resolution — 4 colors or shades of grey
512×256 resolution — 16 colors or shades of grey

Models are available with a second VSV11/VS11 memory module which provides the following:
512×512 resolution — 16 colors or shades of grey
512×256 resolution — 16 colors or shades of grey with dynamic graphics.

High speed
The VSV11 and VS11 are designed for rapid generation and display of graphics. DMA (direct memory access) techniques provide high speed access to the host computer.

When a picture has been loaded to the VSV11/VS11, the integral Image Processor with its bit-slice microprocessor architecture ensures rapid processing of graphics information. The VSV11/VS11 dynamic graphics capability, on models with a second memory module, provides smooth, high speed picture update.
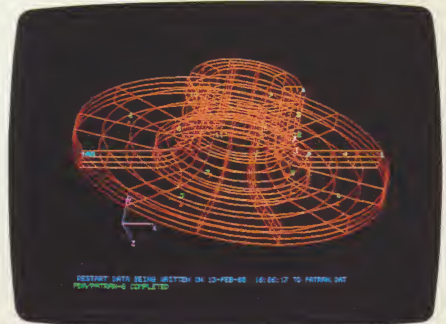
Versatile instruction set
The VSV11/VS11 instruction set facilitates picture construction and display for the user. By using simple commands, the user can access such functions as ....
— calling a pre-programmed character or sub-picture
— drawing lines, vectors, histograms or graphs
— addressing any point on the screen
— moving a block of pixel data from host memory to the VSV11 and VS11 (bit-map mode), with optional automatic expansion and smoothing for high quality picture content.

Applications

The VSV11 and VS11 can be used in a wide range of applications, wherever operators must interpret large quantities of complex information quickly and accurately.

The following are just a few of the many areas where the VSV11 and VS11 ensure fast, efficient man-machine communication …

Network control

Computer-generated graphics are being used increasingly in the management of all types of network: plant vehicle traffic, railways, distribution of utilities such as gas and electricity, etc.

Using the VSV11/VS11 graphics facilities, full color mimic diagrams can be constructed which depict a network in an unambiguous and easy-to-follow form. Then, as changes in the network occur, the diagrams are overlaid with new information.

In this way, controllers are kept fully aware of the status of the network at all times. They can also interact with the computer system by inputting commands via their VSV11/VS11 keyboard or joystick.

Process monitoring and control

In the manufacturing industries, the speed with which operators react to changes in the process they are monitoring is often a crucial factor. The VSV11/VS11 can increase efficiency and productivity by rapidly displaying real-time production data, in pictorial forms which can be readily understood by operators.

Alarms/critical states can be represented by color-coding or by 'blinking', so that operators will immediately identify areas requiring attention.

Simulation tests can be run on the VSV11/VS11, to assess the potential effects of changes in operating parameters (e.g. pressure, temperature, product ingredients). In consequence, operators can be helped to make the right decisions during actual production.

Business graphics

The VSV11/VS11 provide a powerful management tool by displaying complex information in forms which are easy to assimilate (bar-charts, histograms, graphs, etc.). The combination of color with graphics means that managers can obtain an 'at a glance' overview of operations and trends, whilst areas requiring further analysis, such as unusually high costs or a reduction in sales, can be highlighted.

Image analysis

Computer-aided image analysis plays a vital part in applications such as satellite and aerial photography and medical X-ray analysis.

Using the sophisticated imaging capabilities of the VSV11/VS11, the user can reconstruct an original image and display it on the screen. The high resolution of the VSV11/VS11 and the choice of colors/intensities available greatly enhance the contrast of the original image, revealing important detail and highlighting features of special interest. As a result, images which in their original form would have been difficult to interpret become valuable sources of information.

Design

The VSV11/VS11 are a significant aid in a wide range of design applications, such as in engineering and construction.

Complex designs can be created and displayed, in full color, and modified via the VSV11/VS11 monitor keyboard or joystick, eliminating the need for tedious re-drawing. The dynamic graphics capability facilitates high speed interpretation of a design.

Software

For users of Digital Equipment's RSX11-M/S and VAX/VMS operating systems, a software driver is included with the VSV11/VS11, which interfaces the user's applications software to the VSV11/VS11 hardware.

The driver supplies QIOs which:
— access the VSV11/VS11 input/output registers
— service interrupts
— perform error-handling
— communicate with the applications task.
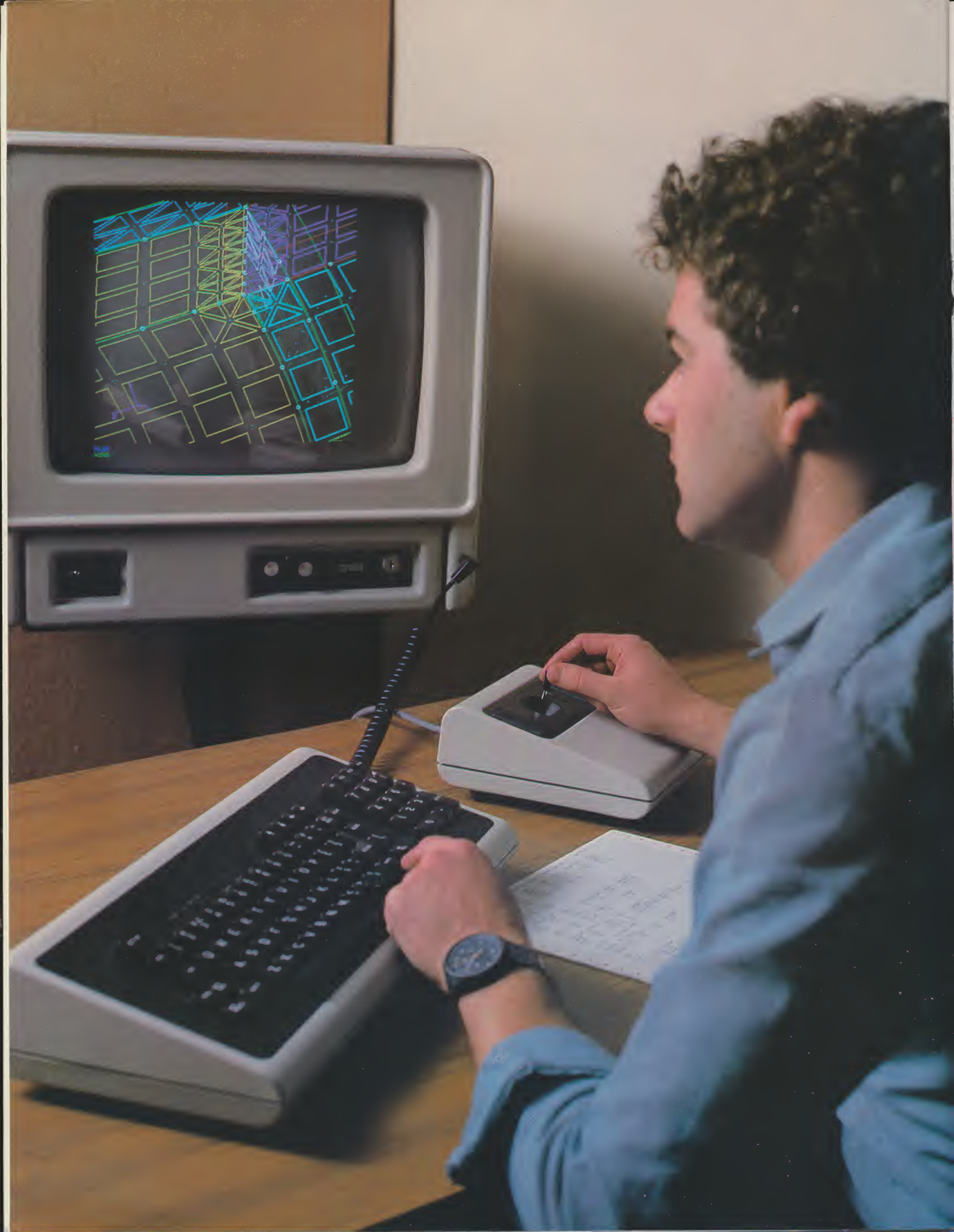
Technical Overview

Organization

The VSV11 and VS11 are designed for use with LSI-Bus computers and UNIBUS computers respectively. Both devices comprise the same basic components; in addition, the VS11 includes a UNIBUS to LSI-Bus converter, to enable operation with UNIBUS computers.

The basic VSV11/VS11 consists of three quad-sized printed circuit boards:

□ *Image Processor.* This is a high performance processor based on 2901 bit-slice microprocessor technology. The processor operates on 64-bit microwords with a 160 nanosecond cycle time. It contains built-in diagnostics to identify malfunctions.

□ *Image Memory.* A complete video frame buffer with half a million bits of memory. The user can switch-select the resolution and number of colors/shades of grey:
$512 \times 512 \times 2$ bits — for interlaced operation, giving 4 colors or shades
$512 \times 256 \times 4$ bits — non-interlaced operation, giving 16 colors or shades
Models configured with two image memory modules will provide a further choice of:
$512 \times 512 \times 4$ bits — interlaced operation, giving 16 colors or shades, static graphics,
or
$512 \times 256 \times 4$ bits — non-interlaced operation, giving 16 colors or shades, dynamic graphics.
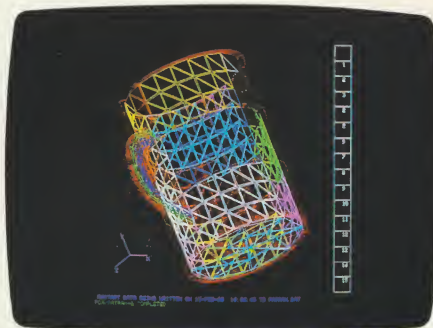
□ *Sync. Generator.* This module synchronizes system operation and provides digital-to-analog conversion for the data to be displayed.

The VSV11/VS11 is always supplied with a rate-type joystick. Models with monitors are also supplied with a keyboard. The keyboard communicates with the host computer via a standard serial line interface at selectable rates from 110 to 9600 baud. The joystick is connected to the Sync. Generator and operates the cursor control circuits on it.

Operation

Data to be displayed by the VSV11/VS11 is first organized into a display file in the memory of the host computer. This file consists of a series of graphics, control and data instructions which define an image to be displayed. When the display file has been constructed, the file is then transferred by loading the starting address of the display file to the VSV11/VS11.

On initiation by the software driver, the Image Processor issues Non-Processor Requests to sequence through the display file instructions. It interprets them and fills the Image Memory with the appropriate data. The Image Memory is scanned by the Sync. Generator which converts the data from digital-to-analog form for display on the monitor screen.

Since the VSV11/VS11 has its own Image Memory, continuous image refresh from the host is not required. After one pass through the memory file, the file may be altered or removed. All screen picture refresh is performed automatically by the VSV11/VS11, at either 50 Hz or 60 Hz.

When the VSV11/VS11 is configured with two memory modules, the memories can be alternately set to Write-only mode and Read-only mode. While one is being scanned by the Sync. Generator, the other can be updated with new data. This provides fast picture update motion, referred to as the "dynamic graphics" option.

VS11 BLOCK DIAGRAM
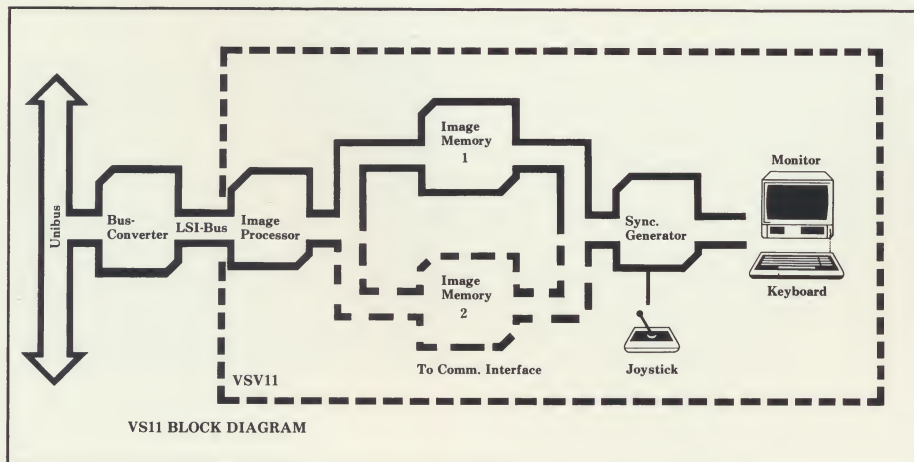
Cursor

The cursor can be positioned either by the user's program, or by means of the rate-type joystick provided with the system. Two cursor sizes are available: a large cursor with full-screen cross-hairs; or a small cursor with 16-pixel long cross-hairs. There is also a choice of two cursor colors or shades.

Under joystick-control, the cursor is moved on the screen at a rate proportional to the displacement of the joystick. The direction in which the cursor moves corresponds to the direction of the joystick displacement.

A Match Interrupt feature, when enabled, causes the display program to be stopped (interrupted) when the current cursor position and the location in the Image Memory being written to are the same (match). This allows identification of the graphics primitive which generates that pixel. This feature allows the joystick on a raster scan display to function similarly to a light pen on a random stroke display.
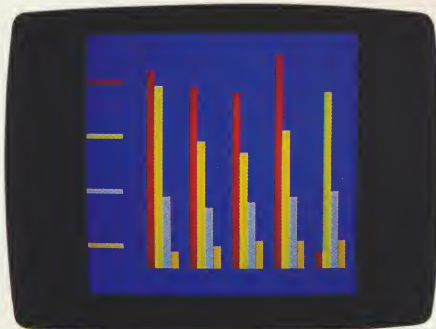
Hardware Blink

This is a programmable feature. When it is enabled, the number of intensities available is reduced from either 16 to 8 i.e. 3 bits, or from 4 to 2 i.e. 1 bit, depending on the memory configuration. In each case, the second most significant bit becomes the blink bit.

Programming

The VSV11/VS11 instruction set is comprised of the following basic types of instructions...

Control instructions. These instructions provide such functions as setting-up initial operating parameters, controlling the display program (e.g. Jumping to a subroutine), and communicating with the control and status registers on the Image Memory.

Graphic-mode instructions. These are used to set the basic operating characteristics of the Display Processor, and determine the interpretation of the Graphic Data Words which follow them:-

□ Character mode
Characters or frequently used symbols can be given a code and stored in the subpicture display file, from where they can be called for display on the screen. The subpicture display file can contain any number of graphic, control and data instructions, but not another character instruction, or DISPLAY JUMP or a BIT MAP instruction.
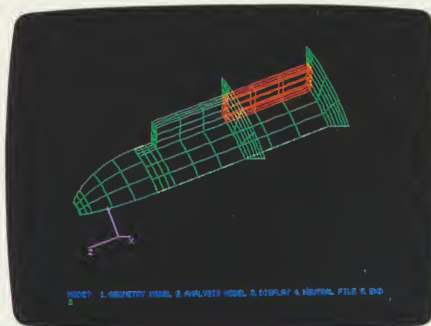
□ **Vector mode**
Lines or vectors are specified in two formats:

Short vector mode
Short lines or vectors, up to 32 pixels, are stored with both X and Y components in one 16-bit Data Word.

Long vector mode
Long vector X-Y data is stored in two 16-bit Data Words. The maximum length of a long vector is 512 pixels.

□ **Point mode**
Points are specified in one of two formats:

Absolute point mode
In the Absolute point mode, any position on the screen can be addressed. The X and Y coordinates are stored in two separate Data Words.

Relative point mode
The X and Y displacement from the current position are specified in a single Data Word.

□ **Graph Plot/Histogram X and Y modes**
This mode simplifies the plotting of X-Y graphs. By setting a constant increment in a special register, only the variable values for one axis need be specified to plot the data. Histograms, bar graphs and points, connected or unconnected, can all be easily plotted.

□ **Run-length mode**
Run-length encoding is a picture data compression technique in which a string (run) of adjacent pixels which have the same color are specified as a count. The instruction fetches successive display file words containing a pixel intensity/color and count and writes the specified number of pixels in the Image Memory starting at the current X-Y position.

□ **Bit map mode 0**
This mode moves a square array of pixel data from the host memory to the Image Memory. Arrays of 32×32, 64×64, 128×128 and 256×256 can be either directly moved or expanded, with or without
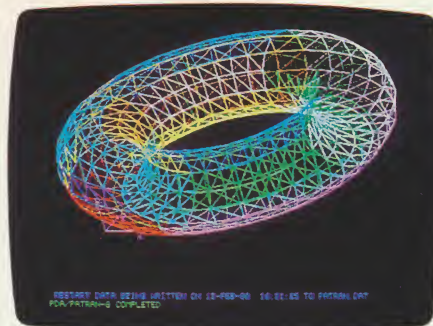
smoothing (linear interpolation), by a factor of 2, 4 or 8.

□ **Bit map mode 1**
This mode allows a specified number of pixels to be fetched from host memory and written into the Image Memory. The maximum number of pixels per data string is 512.

□ **DMA pixel readback**
This function causes a rectangular area of image memory to be read into the host computer's memory in bit-map format. The data may be packed four 4-bit pixels per word or two 8-bit pixels per word. Masking of unwanted bits is provided.
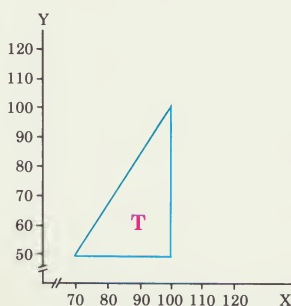

SAMPLE PROGRAM

```
           176066    SET UP MEMORY CHANNEL 0 FOR READ/WRITE
           170140    CLEAR IMAGE MEMORY
           116100    ABSOLUTE POINT INSTRUCTION + COLOR BLUE
           040310    INTENSIFY + X=100
           000310    Y=100
           110000    LONG VECTOR INSTRUCTION
           040000    INTENSIFY + DELTA X=0
           020144    DELTA Y=-50
           060074    INTENSIFY + DELTA X=-30
           000000    DELTA Y=0
           040074    INTENSIFY + DELTA X=30
           000144    DELTA Y=50
           020024    DELTA X=-10
           020120    DELTA Y=-40
           152000    SET CHARACTER BASE ADDRESS TO

           CHDSTB    CHARACTER DISPATCH TABLE
           102200    ENTER CHARACTER MODE WITH COLOR RED
           000124    CHARACTER CODES T AND NULL
           172000    DISPLAY STOP INSTRUCTION
CHDSTB:    NULL      CHARACTER DISPATCH TABLE
           .=.+246
           TDRAW
TDRAW      104000    SHORT VECTOR INSTRUCTION
           040022    INTENSIFY + DELTA X=0, DELTA Y=9
           022402    DELTA X=-5.DELTA Y=1
           045000    INTENSIFY + DELTA X=10.DELTA Y=0
NULL:      165000    DPOP INSTRUCTION

           .END
```
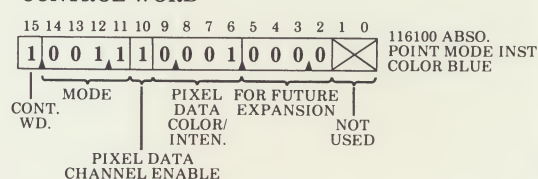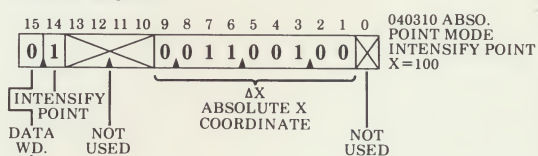
Y
120 —
110 —
100 —
90 —
80 —
70 —
60 —   T
50 —
    └─┼──┼──┼──┼──┼──┼── X
      70 80 90 100 110 120

CONTROL WORD

| 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 |
| 1 0 0 1 1 1 0 0 0 1 0 0 0 0 ☒ |

116100 ABSO. POINT MODE INST COLOR BLUE

CONT. WD.
MODE
PIXEL DATA COLOR/INTEN.
FOR FUTURE EXPANSION
NOT USED
PIXEL DATA CHANNEL ENABLE

DATA WORD 1

| 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 |
| 0 1 ☒ 0 0 1 1 0 0 1 0 0 ☒ |

040310 ABSO. POINT MODE INTENSIFY POINT X=100

INTENSIFY POINT
ΔX ABSOLUTE X COORDINATE
DATA WD.
NOT USED
NOT USED

| 0 ☒ 0 0 1 1 0 0 1 0 0 ☒ |

000310 ABSO. POINT MODE Y=100

DATA WORD 2
ΔY ABSOLUTE Y COORDINATE

Specifications

VSV11:	LSI-Bus compatible. Basic system includes M7064 Image Processor, M7062 Image Memory, M7061 Sync Generator, and H3060 Joystick.
VS11:	PDP-11 and VAX UNIBUS compatible. Basic system includes M7064, M7062, M7061, H3060, and a DW11-BK.
Image Processor	M7064 Quad-size +5V, 3.0A (nominal) Data Transfer Mode: LSI-Bus NPRs. Bus load 1.
Image Memory	M7062 Quad-size +5V, 1.5A and +12V, .5A (nominal) Resolution: 512×512×2 bits or 512×256×4 bits. Output Pixel Rate: 1 pixel per 80 nsec. Input Data Rate to Memory: 1 pixel per 640 nsec.
Sync. Generator	M7061 Quad-size +5V, 1.5A and +12V, .15A (nominal) Horiz. freq: 15.734KHz
Scan lines per field	60Hz Interlace 525 (629-50Hz) 60Hz Non-interlace 262 (315-50Hz)
Visible lines per field	60Hz Interlace 480 (512-50Hz) 60Hz Non-interlace 240 (256-50Hz)
Video Output	To RS-170 Composite or R.G.B.
DW11-BK Bus converter	Supplied with UNIBUS configurations only. Comprises: DDV11-CK 4-slot backplane for a BA11-L,-K,-F, or -P Expander Box; M8217 Bus Converter module and cable — Quad-size +5V, 3.0A and -15V, .5A.

Display Monitors

Monochrome:

Monitor screen	VT100-LA (LB) — 12 inch VT100-AA with a P40 phosphor CRT and anti-glare shield.
Power Requirement	120Vac, 2.2A (nominal) 240 Vac, 1.1A

Color:

Monitor screen	VRV02-BA (BB) — 19 inch, in-line gun CRT.
Dot pitch:	.31mm
Bandwidth:	25 MHz
Resolution:	1280/720 trio dots horizontal. 960/540 trio dots vertical.
Power Requirement	120Vac, 1.5A (nominal) 240 Vac, .8A

Input Device

Joystick:	H3060 — Rate-type joystick
Keyboard:	VT100-style keyboard with associated hardware in a free-standing enclosure. Keyboard with enclosure 120Vac, 1.5A (nominal) 240Vac, .8A

Ordering Information

Options

Given below is a list of option designations and descriptions of VSV11/VS11 systems now being offered.

VSV11/ VS11	LSI-BUS/ UNIBUS RASTER GRAPHICS 120V/60Hz 240V/50Hz		SECOND FRAME BUFFER	12" B/W MONITOR WITH KEYBOARD VT100-LA (LB)	19" COLOR MONITOR WITH KEYBOARD VRV02-BA (BB)
AA	X				
AB		X			
AC	X		X		
AD		X	X		
AE	X			X	
AF		X		X	
AH	X		X	X	
AJ		X	X	X	
AP	X				X
AR		X			X
AS	X		X		X
AT		X	X		X

Configurations

VSV11	Prerequisites H9273-A backplane, BA11-N Expander Box, and a serial line interface and a cable for the keyboard. Modules plug directly into H9273-A backplane which mounts in BA11-N Expander Box. Modules must occupy unreserved contiguous slots in the backplane.
VS11	Includes DDV11-CK backplane and M8217 UNIBUS converter. The M8217 UNIBUS converter is plugged into a user-supplied UNIBUS SPC slot (DD11-C/D or equivalent). The DDV11-CK backplane mounts directly into user-supplied BA11-L or -K Expander Box. A harness adapter is included for mounting in the BA11-For-P box. A serial line interface and a cable for the keyboard is a prerequisite.

Software

Software drivers are supplied at no extra cost to the customer. To ensure receiving the driver distribution; enter one of the following kits as a line item (N/C) when completing the order:

VAX/VMS Driver for VS11

QES28-XM	9 Track 1600 bpi Mag tape
QES28-XY	RX01 Diskette

RSX-11M Driver for VSV11/VS11

QJS27-XD	9 Track 800 bpi Mag tape
QJS27-XE	RK05 Disk
QJS27-XG	TU58 DECtape II
QJS27-XM	9 Track 1600 bpi Mag tape
QJS27-XQ	RL01 Disk
QJS27-XY	RX01 Diskette

The drivers are distributed with a sources, binaries and documentation as a customer installed, Digital supported products.

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COMPUTER SPECIAL SYSTEMS